

REMARKS/ARGUMENTS

In the Final Office Action of May 26, 2011, claims 1-10 were rejected. However, Applicants hereby request reconsideration of the application in view of the below-provided remarks.

Withdrawal of Finality

Applicants respectfully note that the present Office Action does not provide an answer to all of Applicants' substantive arguments from Applicants' previous response. The MPEP requires that, in response to Applicants' traversal of the rejection, the examiner should take note of Applicants' argument and answer the substance of it. MPEP 707.7(f).

Specifically, Applicants presented the following arguments in Applicants' previous response:

"Wang teaches that a pre-amorphization implantation (206) is carried out on a substrate (200) to form an amorphized region (208). (See Fig. 2B and paragraph [0026] of Wang). The Office Action suggests that the amorphized region (208) of Wang is equivalent to the "*first amorphous layer*" of claim 1. (See page 3 of the Office Action). In addition, as shown in step S112 in Fig. 1, Fig. 2D and step S312 in Fig. 3, Wang teaches that a doped source/drain region (218) is formed in a lower portion of the amorphized region (208) under a doped source/drain extension region (212) on each side of a spacer (214) and is not on the surface of the substrate (200). (See also paragraphs [0027], [0029], [0031], [0039], and [0041] of Wang). The Office Action suggests that the doped source/drain region (218) of Wang is equivalent to the "*second amorphous layer*" of claim 1. (See page 3 of the Office Action).

Keys teaches that recrystallization inhibitors (206) are implanted into a surface area of an amorphous region (202) that is on the surface a semiconductor substrate. (See Fig. 2A and paragraph [0025] of Keys). The Office Action suggests that the amorphous region (202) of Keys is equivalent to the "*first amorphous layer*" of claim 1. (See page 4 of the Office Action). In addition, Keys teaches that the recrystallization inhibitors (206) are capable of inhibiting or substantially retarding the solid phase epitaxial regrowth (or recrystallization) of a semiconductor substrate that has been amorphized. (See paragraph [0025] of Keys). Keys also teaches that dopants (207) can be implanted into the surface area of the amorphous region (202) that includes the recrystallization inhibitor region 206 to create shallow source/drain extensions. (See Fig. 2B and paragraph [0027] of Keys). Furthermore, Keys teaches that before or after the dopants (207) are implanted into the amorphous region (202), the amorphous region (202) is partially recrystallized. (See Figs. 2A and 2B and paragraphs [0029] of Keys). Keys also teaches that the part of the amorphous region (202) that does not have the recrystallization inhibitors (206) recrystallizes to form a recrystallized region (211) and the surface area of the amorphous region (202) that includes the recrystallization inhibitors (206) remains amorphous after the partial recrystallization. (See Fig. 2B and

paragraphs [0028] and [0030] of Keys). Lastly, Keys teaches that defects (208) are spatially separated from the surface area of the amorphous region (202) that includes the recrystallization inhibitors (206). (See Fig. 2B and paragraph [0030] of Keys). That is, Keys teaches partially recrystallizing the amorphous region (202) such that the surface area of the amorphous region (202) remains amorphous after the partial recrystallization and is separated from defects to allow a shallow junction to form.

Because Keys teaches partially recrystallizing the amorphous region (202) such that the surface area of the amorphous region (202) remains amorphous, combining the teachings of Wang and Keys would result in that the doped source/drain region (218) of Wang is formed on the surface of the substrate (200). Because Wang teaches that the doped source/drain region (218) is formed in a lower portion of the amorphized region (208) under the doped source/drain extension region (212), combining the teachings of Wang and Keys would result in that the doped source/drain extension region (212) of Wang is located outside of the substrate (200), which causes the semiconductor transistor of Wang to be ineffective. Therefore, Applicants respectfully assert that a person of ordinary skill in the art at the time of the invention was made would not combine the teachings of Wang and Keys, as suggested in the Office Action. Thus, Applicants respectfully assert that the articulated reasoning provided in the Office Action with respect to combining the teachings of Wang and Keys is not based on a rational underpinning. As a result, Applicants respectfully assert that a *prima facie* case of obviousness rejection have not been established with respect to claim 1.” (See pages 5-7 of Applicants’ previous response).

Applicants respectfully submit that the present Office Action fails to acknowledge the above-identified Applicants’ arguments. Specifically, the present Office Action states:

“Examiner disagrees that there is no need for further amorphizing a layer that is already amorphous. How amorphous a layer is does change the characteristic of a layer; it matters whether the layer is amorphized more or less.” (See the section titled “Response to Arguments” on page 2 of the Final Office Action).

However, the present Office Action fails to acknowledge Applicants’ assertion that “[b]ecause Keys teaches partially recrystallizing the amorphous region (202) such that the surface area of the amorphous region (202) remains amorphous, combining the teachings of Wang and Keys would result in that the doped source/drain region (218) of Wang is formed on the surface of the substrate (200).” In addition, the present Office Action fails to acknowledge Applicants’ assertion that “[b]ecause Wang teaches that the doped source/drain region (218) is formed in a lower portion of the amorphized region (208) under the doped source/drain extension region (212), combining the teachings of Wang and Keys would result in that the doped source/drain extension region (212) of Wang is located outside of the substrate (200), which causes the semiconductor transistor

of Wang to be ineffective.” Therefore, Applicants repeat the substantive arguments herein and request that the Examiner provide answers to the arguments.

In addition, Applicants presented the following arguments in Applicants’ previous response:

“Claim 8 has been amended to recite in part “*wherein the second area is located closer to the top surface of said semiconductor substrate than the first area*” (emphasis added). Support for the amendment to claim 8 is found in Applicants’ specification at, for example, Fig. 3 and page 5, lines 16-24. Applicants respectfully assert that Wang in view of Xiang does not teach all of the limitations of amended claim 8. In addition, Applicants respectfully assert that the articulated reasoning provided in the Office Action with respect to combining the teachings of Wang and Xiang is not based on a rational underpinning.

Applicants respectfully assert that Wang in view of Xiang does not teach all of the limitations of amended claim 8.

Applicants respectfully assert that Wang in view of Xiang does not teach all of the limitations of amended claim 8. Specifically, Applicants respectfully assert that neither Wang nor Xiang teaches “*wherein the second area is located closer to the top surface of said semiconductor substrate than the first area*” (emphasis added), as recited in amended claim 8.

The Office Action on page 6 suggests that Wang teaches all of the limitations of claim 8 except the limitation “*said first area having a thickness of 2-6 nm.*” Xiang is cited for teaching the limitation “*said first area having a thickness of 2-6 nm*” of claim 8. The Office Action then concludes that “[i]t would have been obvious to a person of ordinary skill in the art at the time of the invention was made, to make the first area have a thickness of 2-6 nm, as taught by Xiang, and therefore make the second area have a thickness of 6-12 nm, for the purpose of speeding recrystallization and amorphization.” (See page 6 of the Office Action).

However, Applicants respectfully assert that Wang does not teach “*wherein the second area is located closer to the top surface of said semiconductor substrate than the first area*” (emphasis added), as recited in amended claim 8. As described above with respect to the rejection of claim 1, Wang teaches that the doped source/drain region (218) is formed in the substrate (200) on each side of the spacer (214). Wang also teaches that a doped source/drain extension region (212) is formed in the substrate (200) on each side of a spacer (205). (See step S108 in Fig. 1, Fig. 2C and step S308 in Fig. 3 and paragraphs [0027], [0031], [0037], and [0040] of Wang). The Office Action suggests that the doped source/drain region (212) of Wang is equivalent to the “*first area having a first conductivity profile*” recited in claim 8. (See page 6 of the Office Action). The Office Action also suggests that the doped source/drain region (218) of Wang is equivalent to the “*second area having a second conductivity profile*” of claim 8. (See page 6 of the Office Action).

However, with respect to Fig. 2D, Wang teach that the doped source/drain region (212) is closer to the top surface of the substrate (200) than the doped source/drain region (218). Because the Office Action suggests that the doped source/drain region (212) of Wang is equivalent to the “*first area having a first conductivity profile*” recited in claim 8 and that the doped source/drain region (218) of Wang is equivalent to the “*second area having a second conductivity profile*” of claim 8, Applicants respectfully assert that Wang does not teach “*wherein the second area is located closer to the top surface of said semiconductor substrate than the first area*” (emphasis added), as recited in amended claim 8.

In addition, Xiang is cited for teaching the limitation “*said first area having a thickness of 2-6 nm*” of claim 8. Applicants respectfully assert that Xiang does not teach the limitation “*wherein the second area is located closer to the top surface of said semiconductor substrate than the first area*” (emphasis added), as recited in amended claim 8. Because Wang in view of Xiang does not teach all of the limitations of amended claim 8, Applicants respectfully assert that amended claim 8 is patentable over Wang in view of Xiang.

Applicants respectfully assert that the articulated reasoning provided in the Office Action with respect to combining the teachings of Wang and Xiang is not based on a rational underpinning

The only statement made by the Examiner in support of an obviousness rejection of claim 8 is that “[i]t would have been obvious to a person of ordinary skill in the art at the time of the invention was made, to make the first area have a thickness of 2-6 nm, as taught by Xiang, and therefore make the second area have a thickness of 6-12 nm, for the purpose of speeding recrystallization and amorphization” (emphasis added), which is a mere conclusory statement and fails to clearly articulate a rationale in support of the obviousness rejection, as required by the MPEP and KSR. In view of the foregoing, Applicants respectfully submit that the Examiner has merely provided a conclusory statement in support of the obviousness rejection and failed to clearly articulate a rational to support his conclusion, as required by the MPEP and KSR. Thus, Applicants respectfully assert that the articulated reasoning provided in the Office Action with respect to combining the teachings of Wang and Xiang is not based on a rational underpinning. Accordingly, Applicants respectfully assert that amended claim 8 is patentable over Wang in view of Xiang.” (See pages 7-9 of Applicants’ previous response).

Applicants respectfully submit that the present Office Action fails to acknowledge the above-identified Applicants’ arguments. The present Office Action fails to acknowledge Applicants’ assertion that neither Wang nor Xiang teaches “*wherein the second area is located closer to the top surface of said semiconductor substrate than the first area*” (emphasis added), as recited in claim 8. In addition, the present Office Action fails to acknowledge Applicants’ assertion that the articulated reasoning provided in the

Office Action with respect to combining the teachings of Wang and Xiang is not based on a rational underpinning. Therefore, Applicants repeat the substantive arguments herein and request that the examiner provide answers to the arguments.

Given that the present Office Action does not answer all of the substantive arguments from Applicants' previous response, Applicants respectfully submit that the finality of the present Office Action is premature. Accordingly, Applicants respectfully request that the finality of the present Office Action be withdrawn.

Claim Rejections under 35 U.S.C. 103

Claims 1-5 were rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Wang et al. (U.S. Pat. App. Pub. No. 2005/0054173, hereinafter "Wang") in view of Keys et al. (U.S. Pat. App. Pub. No. 2004/0235280, hereinafter "Keys"). Claim 6 was rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Wang in view of Keys, and further in view of Sultan et al. (U.S. Pat. No. 6,063,682, hereinafter "Sultan"). The Final Office Action on page 5 states that claim 7 was rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Wang in view of Keys, and further in view of Xiang et al. (U.S. Pat. No. 6,555,439, hereinafter "Xiang"). However, Applicants note that claim 7 was actually rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Wang in view of Keys, and further in view of Maszara et al. (U.S. Pat. No. 6,362,063, hereinafter "Maszara"). Claims 8-10 were rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Wang in view of Xiang. However, Applicants respectfully submit that the pending claims 1-10 are patentable over the cited reference.

Independent Claim 1

Claim 1 recites:

*"Method of producing a semiconductor device comprising:
a) providing a semiconductor substrate,
b) making a first amorphous layer in a top layer of said semiconductor substrate by a suitable implant, said first amorphous layer having a first depth,
c) implanting a first dopant into said semiconductor substrate to provide said first amorphous layer with a first doping profile,
d) applying a first solid phase epitaxial regrowth action to partially regrow said first amorphous layer and form a second amorphous layer having a second depth that is less than said first depth and activate said first dopant,
e) implanting a second dopant into said semiconductor substrate to provide said*

second amorphous layer with a second doping profile with a higher doping concentration than said first doping profile,

f) applying a second solid phase epitaxial regrowth action to regrow said second amorphous layer and activate said second dopant.”

As described above in the section titled “Withdrawal of Finality,” Applicants respectfully assert that a *prima facie* case of obviousness rejection have not been established with respect to claim 1. Specifically, Applicants respectfully assert that the articulated reasoning provided in the Final Office Action with respect to combining the teachings of Wang and Keys is not based on a rational underpinning.

In order to establish a *prima facie* case of obviousness of a claim under 35 U.S.C. 103, the Office Action must present a clear articulation of the reason why the claimed invention would have been obvious. MPEP 2142 (citing *KSR International Co. v. Teleflex Inc.*, 550 U.S. 398 (2007)). The analysis must be made explicit. *Id.* Additionally, rejections based on obviousness cannot be sustained by mere conclusory statements; instead there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. *Id.*

The Final Office Action acknowledges that Wang does not teach the limitations “*applying a first solid phase epitaxial regrowth action to partially regrow said first amorphous layer and form a second amorphous layer having a second depth that is less than said first depth and activate said first dopant*,” as recited in claim 1. (See page 3 of the Final Office Action). In addition, the Final Office Action suggests that Keys teaches the above-identified limitation of claim 1. (See page 3 of the Final Office Action). The Final Office Action concludes that “[i]t would have been obvious to a person of ordinary skill in the art at the time of the invention was made, to partially regrow the first amorphous layer, as taught by Keys, for the purpose of forming shallow junctions” (emphasis added). (See page 3 of the Final Office Action). However, Applicants respectfully assert that a person of ordinary skill in the art at the time of the invention was made would not combine the teachings of Wang and Keys, as suggested in the Final Office Action.

Wang teaches that a pre-amorphization implantation (206) is carried out on a substrate (200) to form an amorphized region (208). (See Fig. 2B and paragraph [0026] of Wang). The Final Office Action suggests that the amorphized region (208) of Wang is

equivalent to the “*first amorphous layer*” as recited in claim 1. (See page 3 of the Final Office Action). In addition, as shown in step S112 in Fig. 1, Fig. 2D and step S312 in Fig. 3, Wang teaches that a doped source/drain region (218) is formed in a lower portion of the amorphized region (208) under a doped source/drain extension region (212) on each side of a spacer (214) and is not on the surface of the substrate (200). (See also paragraphs [0027], [0029], [0031], [0039], and [0041] of Wang). The Final Office Action suggests that the doped source/drain region (218) of Wang is equivalent to the “*second amorphous layer*” as recited in claim 1. (See page 3 of the Final Office Action).

Keys teaches that recrystallization inhibitors (206) are implanted into a surface area of an amorphous region (202) that is on the surface a semiconductor substrate. (See Fig. 2A and paragraph [0025] of Keys). The Final Office Action suggests that the amorphous region (202) of Keys is equivalent to the “*first amorphous layer*” as recited in claim 1. (See page 3 of the Final Office Action). In addition, Keys teaches that the recrystallization inhibitors (206) are capable of inhibiting or substantially retarding the solid phase epitaxial regrowth (or recrystallization) of a semiconductor substrate that has been amorphized. (See paragraph [0025] of Keys). Keys also teaches that dopants (207) can be implanted into the surface area of the amorphous region (202) that includes the recrystallization inhibitor region 206 to create shallow source/drain extensions. (See Fig. 2B and paragraph [0027] of Keys). Furthermore, Keys teaches that before or after the dopants (207) are implanted into the amorphous region (202), the amorphous region (202) is partially recrystallized. (See Figs. 2A and 2B and paragraphs [0029] of Keys). Keys also teaches that the part of the amorphous region (202) that does not have the recrystallization inhibitors (206) recrystallizes to form a recrystallized region (211) and the surface area of the amorphous region (202) that includes the recrystallization inhibitors (206) remains amorphous after the partial recrystallization. (See Fig. 2B and paragraphs [0028] and [0030] of Keys). Lastly, Keys teaches that defects (208) are spatially separated from the surface area of the amorphous region (202) that includes the recrystallization inhibitors (206). (See Fig. 2B and paragraph [0030] of Keys). That is, Keys teaches partially recrystallizing the amorphous region (202) such that the surface area of the amorphous region (202) remains amorphous after the partial recrystallization and is separated from defects to allow a shallow junction to form.

Because Keys teaches partially recrystallizing the amorphous region (202) such that the surface area of the amorphous region (202) remains amorphous, combining the teachings of Wang and Keys would result in that the doped source/drain region (218) of Wang is formed on the surface of the substrate (200). In addition, because Wang teaches that the doped source/drain region (218) is formed in a lower portion of the amorphized region (208) under the doped source/drain extension region (212), combining the teachings of Wang and Keys would result in that the doped source/drain extension region (212) of Wang is located outside of the substrate (200), which causes the semiconductor transistor of Wang to be ineffective. Therefore, Applicants respectfully assert that a person of ordinary skill in the art at the time of the invention was made would not combine the teachings of Wang and Keys, as suggested in the Final Office Action. Thus, Applicants respectfully assert that the articulated reasoning provided in the Final Office Action with respect to combining the teachings of Wang and Keys is not based on a rational underpinning. As a result, Applicants respectfully assert that a *prima facie* case of obviousness rejection have not been established with respect to claim 1.

Dependent Claims 2-7

Claims 2-7 ultimately depend from and incorporate all of the limitations of independent claim 1. Thus, Applicants respectfully assert that claims 2-7 are allowable at least based on an allowable claim 1.

Independent Claim 8

Claim 8 recites:

“Semiconductor device made by a solid phase epitaxial regrowth technique, comprising a semiconductor substrate with a first area having a first conductivity profile and a second area having a second conductivity profile, the second area having a thickness of 6-12 nm and being located adjacent to a top surface of said semiconductor substrate, and said first area having a thickness of 2-6 nm and being located adjacent to said second area, said second conductivity profile having a lower conductivity than said first conductivity profile, wherein the second area is located closer to the top surface of said semiconductor substrate than the first area” (emphasis added).

As described above in the section titled “Withdrawal of Finality,” Applicants respectfully assert that Wang in view of Xiang does not teach all of the limitations of

claim 8. In addition, Applicants respectfully assert that the articulated reasoning provided in the Final Office Action with respect to combining the teachings of Wang and Xiang is not based on a rational underpinning. Accordingly, Applicants respectfully assert that claim 8 is patentable over Wang in view of Xiang.

Applicants respectfully assert that Wang in view of Xiang does not teach all of the limitations of claim 8.

Applicants respectfully assert that Wang in view of Xiang does not teach all of the limitations of claim 8. The Final Office Action on page 6 suggests that Wang teaches all of the limitations of claim 8 except the limitation “*said first area having a thickness of 2-6 nm.*” Xiang is cited for teaching the limitation “*said first area having a thickness of 2-6 nm*” as recited in claim 8. The Final Office Action then concludes that “[i]t would have been obvious to a person of ordinary skill in the art at the time of the invention was made, to make the first area have a thickness of 2-6 nm, as taught by Xiang, and therefore make the second area have a thickness of 6-12 nm, for the purpose of speeding recrystallization and amorphization” (emphasis added). (See page 6 of the Final Office Action).

As described above with respect to the rejection of claim 1, Wang teaches that the doped source/drain region (218) is formed in the substrate (200) on each side of the spacer (214). Wang also teaches that a doped source/drain extension region (212) is formed in the substrate (200) on each side of a spacer (205). (See step S108 in Fig. 1, Fig. 2C and step S308 in Fig. 3 and paragraphs [0027], [0031], [0037], and [0040] of Wang). In addition, Wang teaches that an amorphized region (208) is formed in the substrate (200).

The Final Office Action on page 7 in the annotated Fig. 2D indicates that the combination of the doped source/drain extension region (212) and the doped source/drain region (218) of Wang is equivalent to the “*second area having a second conductivity profile*” as recited in claim 8. In addition, the Final Office Action on page 7 in the annotated Fig. 2D indicates that the amorphized region (208) of Wang below the doped source/drain region (218) is equivalent to the “*first area having a first conductivity profile*” as recited in claim 8.

However, Applicants respectfully assert Wang does not teach that the conductivity profile of the combination of the doped source/drain extension region (212) and the doped source/drain region (218) (“*second area having a second conductivity profile*”) is lower than the conductivity profile of the amorphized region (208) below the doped source/drain region (218) (“*first area having a first conductivity profile*”). Because Wang does not teach that the conductivity profile of the combination of the doped source/drain extension region (212) and the doped source/drain region (218) is lower than the conductivity profile of the amorphized region (208), Applicants respectfully assert that Wang does not teach “said second conductivity profile having a lower conductivity than said first conductivity profile” (emphasis added), as recited in claim 8.

Applicants respectfully assert that the articulated reasoning provided in the Final Office Action with respect to combining the teachings of Wang and Xiang is not based on a rational underpinning.

The only statement made by the Examiner in support of an obviousness rejection of claim 8 is that “[i]t would have been obvious to a person of ordinary skill in the art at the time of the invention was made, to make the first area have a thickness of 2-6 nm, as taught by Xiang, and therefore make the second area have a thickness of 6-12 nm, for the purpose of speeding recrystallization and amorphization” (emphasis added), which is a mere conclusory statement and fails to clearly articulate a rationale in support of the obviousness rejection, as required by the MPEP and *KSR*. The Examiner failed to clearly articulate why the combination of the teachings of Wang and Xiang would speed recrystallization and amorphization. In addition, the Examiner also failed to clearly articulate how the teachings of Wang and Xiang would be combined to speed recrystallization and amorphization.

In view of the foregoing, Applicants respectfully submit that the Examiner has merely provided a conclusory statement in support of the obviousness rejection and failed to clearly articulate a rational to support his conclusion, as required by the MPEP and *KSR*. Thus, Applicants respectfully assert that the articulated reasoning provided in the Final Office Action with respect to combining the teachings of Wang and Xiang is not

based on a rational underpinning. Accordingly, Applicants respectfully assert that claim 8 is patentable over Wang in view of Xiang.

Dependent Claims 9 and 10

Claims 9 and 10 ultimately depend from and incorporate all of the limitations of independent claim 8. Thus, Applicants respectfully assert that claims 9 and 10 are allowable at least based on an allowable claim 8.

CONCLUSION

Generally, in this Response to the Final Office Action, Applicants have not raised all possible grounds for (a) traversing the rejections of the Final Office Action or (b) patentably distinguishing any new or currently amended claims (i.e., over the cited references or otherwise). Applicants however, reserve the right to explicate and expand on any ground already raised and/or to raise other grounds for traversing and/or for distinguishing, including, without limitation, by explaining and/or distinguishing the subject matter of the Application and/or any cited reference at a later time (e.g., in the event that this Application does not proceed to issue with the current pending claims, or in the context of a continuing application). Applicants submit that nothing herein is, or should be deemed to be, a disclaimer of any rights, acquiescence in any rejection, or a waiver of any arguments that might have been raised but were not raised herein, or otherwise in the prosecution of this Application, whether as to the original claims or as to any of the new or amended claims, or otherwise. Without limiting the generality of the foregoing, Applicants reserve the right to reintroduce one or more of the original claims in original form or otherwise so as to claim the subject matter of those claims, both/either at a later time in prosecuting this Application or in the context of a continuing application.

Applicants respectfully request reconsideration of the claims in view of the remarks made herein. A notice of allowance is earnestly solicited.

At any time during the pendency of this application, please charge any fees required or credit any over payment to Deposit Account **50-4019** pursuant to 37 C.F.R.

1.25. Additionally, please charge any fees to Deposit Account **50-4019** under 37 C.F.R. 1.16, 1.17, 1.19, 1.20 and 1.21.

Respectfully submitted on behalf of:

NXP N.V.

Date: July 15, 2011

By: /thomas h. ham/
Thomas H. Ham
Reg. No. 43,654

Wilson & Ham
1811 Santa Rita Road,
Suite 130
Pleasanton, CA 94566
Phone: (925) 249-1300
Fax: (925) 249-0111